

AEROLOGICAL OBSERVATIONS

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Mean free-air data based on airplane weather observations during the month of September 1937 are given in tables 1 to 3. A description of the methods by which the various monthly means and normals therein are computed may be found in the aerological section of the MONTHLY WEATHER REVIEW for January and March 1937.

It will be noted that many of the "normals" are based on only 3 years of observation. Conclusions based on departures from such short-period "normals" must be used with caution.

The mean surface temperatures for September (see chart I) were generally above normal in the western two-thirds of the country and below normal in the eastern third except for small areas in the extreme southeast, and northeast. The positive departures in the west averaged about 2°C ., while the departures of opposite sign in the east averaged about -1°C . The small areas last referred to had departures mostly less than $+0.8^{\circ}\text{C}$.

The mean free-air temperatures for the month up to 5 kilometers were generally below normal over the country with the exception of the extreme southwest, possibly the central part of the Western Plateau Region, and the eastern Gulf States at high levels (Pensacola 3 to 5 kilometers only). Negative departures were most marked in the northeastern sector of the country, especially near the Great Lakes and the middle Atlantic coast, as exemplified by the data for Chicago, Selfridge Field, Wright Field, Lakehurst, Washington, D. C., and Norfolk where the greatest departure was -3.2°C ., but the average nearly -2°C . This regime of subnormal temperatures appeared to be associated with the similar one observed near the surface in south-central Canada and eastern United States. Over the extreme northwest the negative departures were also appreciable at the higher elevations (-2.3°C at 5 kilometers near Spokane). Elsewhere the negative departures were mostly slight (near 1°C or less). The positive departures which occurred were only of consequence at low or moderate elevations over the extreme southwest and the central plateau regions, with the greatest values $+2.2^{\circ}\text{C}$ near San Diego at 1.5 kilometers, and $+1.8^{\circ}\text{C}$ near Cheyenne at 2 kilometers, but the average values appreciably less.

The mean free-air relative humidities and specific humidities are given in table 2. Generally speaking, the relative humidities did not depart greatly from the normal over most of the country. However, they were largely subnormal to a moderate extent (-5 to -9 percent) over the middle Atlantic and east Gulf coastal areas, particularly at the moderate and higher elevations (2 or 3 to 5 kilometers), and to a slightly greater extent over the south-central part of the country at the lower elevations. This was most marked near San Antonio, Tex. (-15 to -11 percent). The northern Great Plains also had moderately subnormal humidities near the surface. In the area restricted to the extreme southwest at 3 kilometers and extending over perhaps the entire southwestern sector of the country at 5 kilometers, notably above-normal humidities prevailed. The maximum departures occurred at the latter height, viz: $+14$ percent, San Diego; $+8$ percent, El Paso; $+11$ percent, San Antonio; $+11$ percent, Cheyenne. Values moderately in excess of the normal were also found at the same elevation over the north-central portion of the country. At lower elevations the departures were generally considerably smaller.

Table 3 shows the monthly mean free-air barometric pressures and equivalent potential temperatures. The lowest mean barometric pressures in continental United States prevailed over the Great Lakes, with the minima mostly near Sault Ste. Marie, Mich., or slightly to the west, and the highest prevailed over the extreme southern part of the country, with no distinct center of concentration for the maximum values. The trend of the mean free-air isobars was generally west to east, with a tendency for slight cyclonic curvature in the northern part of the country. The average pressure gradients were practically everywhere of weak intensity.

Table 4 shows the free-air resultant winds based on pilot-balloon observations made near 5 a. m. (75th meridian time) during September. The resultant winds were near normal in direction and slightly below normal in velocity, with a few exceptions. Not mentioning cases with very small resultant velocities, the month's resultant wind directions at stations along the middle and south Pacific coastal area were oriented from about 35° to, in one instance, 160° counterclockwise from normal, that is, with southerly replacing westerly directions to some extent. At 3 kilometers near Seattle, a clockwise orientation with respect to the normal of about 60° occurred (i. e., N replacing NW). In the vicinity of the coast of the Gulf of Mexico some abnormal resultant directions also predominated, as exemplified by the data for Houston (60° to 85° counterclockwise from normal from 2 to 3 kilometers), Pensacola (32° to 140° counterclockwise), and Key West (nearly 20° counterclockwise up to 2 kilometers, 115° to 160° clockwise at 2.5 and 3 kilometers respectively); or generalizing, northeast or north replacing southeast or east directions in the former two cases, and southwest or west replacing southeast in the latter case at the higher elevations referred to.

Table 5 shows the maximum free-air wind velocities and their directions for various sections of the United States during September as determined by pilot balloon observations. The extreme maximum was 50 m. p. s. from the west-southwest at 11,560 meters above sea level over Rock Springs, Wyo.

The mean monthly specific humidities and equivalent potential temperatures are shown in tables 2 and 3 respectively. With respect to both these elements, the minima occurred near the Great Lakes, and the maxima near the extreme southeastern portion of Western Plateau, with center in the vicinity of El Paso. The curl of the lines of constant value of the elements in question thus gave evidence of a mean anticyclonic trajectory of the air from the Pacific southwest coast over the southern portion of the plateau, and of a less marked cyclonic trajectory from southwestern Canada over the northern, especially northeastern, part of the United States.

During September the eastern third of the country was largely dominated by rather extensive anticyclones of Pc origin which entered the country mostly from south-central Canada. The invasions of the relatively cool and dry air masses from the north and northwest tended to block off to a considerable extent and more frequently than normal the customary alternating outbreaks of warm, moist, air from the Gulf of Mexico and the tropical Atlantic Ocean. These conditions gave rise to the occurrence of subnormal temperatures in the East as already indicated and to the pressure of relatively dry air over

the Gulf and thence also over the south central part of the country at the lower elevations under the influence of the prevailing circulation. On several occasions, disturbances along fronts formed between advancing Pc air masses and opposing Ta air in the lower Mississippi Valley were there conducive to normal or excessive precipitation (100-200 percent). Most of the eastern third of the country had deficient precipitation (25 to 80 percent of normal), except along the east Florida and the New England coastal areas where the rainfall was approximately normal or somewhat in excess of normal.

The western half of the country was for a considerable period of the month under the dominance of successive anticyclones of Pp origin. Subsidence with attendant low relative humidities was rather widespread in the Pp air masses thus passing over the Western Plateau; and a pronounced abnormal transport of air occurred at moderate and higher elevations from the south or southwest across the central or south Pacific coast as a consequence of the high pressure distribution. The circulation from the Gulf of Mexico also on a number of occasions brought

moist and fairly warm air into the southern portion of the plateau. This was, therefore, a center of high moisture content, moderate or low relative humidities but depressed isentropic surfaces. These conditions in conjunction with the sunshine prevalent during the anticyclonic clear skies were effective in producing abnormally warm weather over a considerable area in the West.

However, they were also effective in bringing about marked deficiency in precipitation over a large fraction of the same area, especially along the Pacific coast and the northern Great Plains, with the average in the latter section about 60 percent of normal, although the rainfall was near normal in the southeastern part of the plateau.

Along the northern border section of the country where the moist air from over the southern plateau had an opportunity to reach condensation levels and ascend to considerable elevations up the slopes of the isentropic and equivalent potential temperature surfaces in the advancing Pc (and occasionally Pp) air masses, the rainfall was generally close to normal or excessive in restricted areas, particularly Michigan and Montana.

TABLE 1.—Mean free-air temperatures (t), °C obtained by airplanes during September 1937. (Dep. represents departure from "normal" temperature)

Station	Num- ber of obs.	Altitude (meters) m. s. l.																	
		Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000	
		t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.
Barksdale Field ¹ (Shreveport), La. (52 m.)	30	20.2	-0.8	22.8	-0.2	20.0	-0.3	17.3	-0.2	14.4	-0.4	11.7	-6.4	9.0	-0.5	3.2	-0.6	-1.8	-0.1
Billings, Mont. ² (1,090 m)	20	12.8	+1.0	-----	-----	-----	-----	14.4	+0.5	11.0	-0.2	7.9	-0.2	4.2	-0.4	-3.7	-1.4	-10.7	-2.1
Boston, Mass. ¹ (5 m)	28	13.7	-----	14.6	-----	11.9	-----	9.9	-----	8.4	-----	6.9	-----	4.7	-----	-0.3	-----	-5.3	-----
Cheyenne, Wyo. ² (1,873 m)	30	10.6	+1.7	-----	-----	-----	-----	13.0	+1.8	13.2	+1.4	10.0	+1.2	2.0	-----	+0.2	-----	-6.0	-0.4
Chicago, Ill. ² (187 m)	30	14.1	-0.7	15.9	-0.7	12.9	-2.3	9.9	-2.7	8.0	-2.4	5.7	-2.2	3.2	-2.0	-2.7	-1.9	-8.3	-1.5
Coco Solo, Canal Zone ² (15 m)	27	24.5	-----	23.5	-----	21.0	-----	18.3	-----	15.6	-----	12.9	-----	10.2	-----	4.1	-----	-1.7	-----
El Paso, Tex. ² (1,194 m)	30	20.2	+0.9	-----	-----	-----	-----	21.3	+0.8	18.6	+0.4	15.2	+0.1	11.3	-0.4	3.8	-0.7	-2.6	-0.7
Fargo, N. Dak. ² (247 m)	29	11.3	+0.6	13.8	+0.2	12.8	+0.3	10.7	+0.2	8.7	+0.5	5.7	+0.1	2.8	+0.1	-3.4	-0.2	-9.8	-0.7
Kelly Field (San Antonio), Tex. ² (206 m)	30	22.2	+0.6	23.2	+0.8	21.1	+0.5	18.1	+0.1	14.9	-0.3	11.9	-0.8	9.1	-0.9	3.0	-1.2	-3.0	-1.0
Lakehurst, N. J. ² (39 m)	26	13.1	-0.7	15.0	-0.3	12.4	-0.4	10.4	-0.8	8.7	-0.8	5.8	-1.6	2.8	-2.1	-3.2	-3.2	-----	-----
Maxwell Field (Montgomery), Ala. ² (52 m)	27	20.7	+0.3	20.5	-1.4	18.1	-1.5	15.9	-1.1	13.6	-1.1	10.4	-1.5	8.1	-1.1	3.1	-0.4	-2.2	+0.2
Mitchell Field (Hempstead, L. I.), N. Y. ¹ (29 m)	24	13.9	-1.1	14.6	-1.0	12.6	-1.0	10.8	-1.2	9.5	-0.6	7.5	-0.7	4.9	-0.7	-1.1	-1.3	-----	-----
Nashville, Tenn. ² (180 m)	29	16.9	-0.9	19.0	-1.2	16.8	-1.4	14.3	-1.1	12.4	-0.6	10.1	-0.2	7.6	0.0	1.9	+0.1	-4.2	+0.2
Norfolk, Va. ² (10 m)	24	18.8	-2.8	18.1	-2.5	14.9	-3.2	13.1	-2.5	11.4	-1.8	9.5	-1.1	7.1	-1.0	1.9	-0.7	-3.5	-0.5
Oakland, Calif. ² (2 m)	30	14.3	-----	17.0	-----	19.2	-----	17.6	-----	15.0	-----	11.8	-----	8.9	-----	2.7	-----	-4.6	-----
Oklahoma City, Okla. ² (391 m)	30	19.1	+0.3	20.4	+0.7	21.3	+1.4	18.8	+1.1	16.0	+0.8	12.8	+0.6	9.5	+0.3	2.9	+0.1	-3.9	-0.3
Omaha, Nebr. ² (300 m)	29	16.2	+0.6	17.9	+0.6	17.4	-0.9	15.1	-1.3	12.7	-1.3	9.8	-1.3	6.8	-1.3	0.3	-1.4	-5.9	-1.1
Pearl Harbor, Hawaii ² (6 m)	30	22.6	-1.6	22.0	+0.2	18.6	+0.5	16.0	+0.9	13.3	+0.7	12.2	+1.0	10.4	+1.1	6.4	+2.4	1.0	+2.1
Pensacola, Fla. ² (13 m)	28	20.9	-2.1	21.8	-0.6	19.2	-0.6	16.7	-0.4	13.6	-0.7	11.4	-0.3	9.3	+0.4	4.0	+0.9	-1.6	+0.9
St. Thomas, Virgin Islands ² (8 m)	30	29.4	-----	25.0	-----	21.8	-----	19.1	-----	16.7	-----	14.2	-----	11.6	-----	6.4	-----	1.6	-----
Salt Lake City, Utah ² (1,288 m)	30	14.6	-----	-----	-----	-----	-----	19.2	-----	17.4	-----	13.9	-----	10.2	-----	2.7	-----	-4.4	-----
San Diego, Calif. ² (10 m)	29	18.8	-0.3	18.6	+1.2	22.1	+2.1	21.4	+2.2	19.1	+1.5	15.9	+1.2	12.5	+0.9	5.6	+0.6	-1.2	+0.1
Sault Ste. Marie, Mich. ² (221 m)	30	11.3	-----	11.8	-----	9.7	-----	7.3	-----	5.1	-----	2.8	-----	0.2	-----	-5.4	-----	-11.4	-----
Scott Field (Belleville), Ill. ² (135 m)	27	13.8	-1.6	17.5	-1.8	15.6	-2.1	13.1	-2.1	11.2	-1.6	8.8	-1.2	6.4	-0.8	0.5	-0.5	-5.9	-0.7
Seattle, Wash. ² (10 m)	11	17.8	-----	15.9	-----	15.5	-----	14.7	-----	12.7	-----	10.6	-----	7.4	-----	1.2	-----	-5.9	-----
Selfridge Field (Mount Clemens), Mich. ¹ (177 m)	30	12.9	-1.1	14.3	-1.5	11.4	-2.4	8.6	-2.8	6.1	-2.9	3.9	-2.8	1.7	-2.5	-3.9	-2.7	-9.6	-2.5
Spokane, Wash. ² (597 m)	29	11.1	+0.5	-----	-----	14.9	+0.1	12.6	-0.4	9.5	-0.2	5.9	-0.4	2.5	-0.7	-4.5	-1.3	-12.0	-2.3
Washington, D. C. ² (13 m)	29	16.1	-3.1	16.3	-2.6	14.1	-2.9	12.0	-2.7	10.2	-2.1	7.9	-2.2	5.3	-2.5	0.6	-2.1	-4.6	-2.3
Wright Field (Dayton), Ohio ² (244 m)	29	12.0	-2.2	16.0	-1.4	14.5	-1.9	11.9	-2.1	9.7	-1.9	7.1	-2.0	4.5	-1.9	-0.9	-1.5	-6.5	-1.2

¹ Army.

² Weather Bureau.

³ Navy.

Observations taken about 4 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—The departures are based on normals covering the following total number of observations made during the same month in previous years, including the current month (years of record are given in parentheses following the number of observations): Barksdale Field, 86 (3); Billings, 108 (4); Cheyenne, 120 (4); Chicago, 90 (3); El Paso, 90 (3); Fargo, 116 (4); Kelly Field, 118 (4); Lakehurst, 66 (3); Maxwell Field, 113 (4); Mitchell Field, 97 (4); Nashville, 118 (4); Norfolk, 146 (7); Oklahoma City, 116 (4); Omaha, 209 (7); Pearl Harbor, 140 (5); Pensacola, 220 (9); San Diego, 222 (9); Scott Field, 105 (4); Selfridge Field, 118 (4); Spokane, 113 (4); Washington, 218 (10); Wright Field, 112 (4).

TABLE 2.—Mean free-air relative humidities (*R. H.*), in percent, and specific humidities (*q*), in grams/kilogram, obtained by airplanes during September 1937 (*Dep.* represents departure from "normal" relative humidity)

Stations	Altitude (meters) m. s. l.																											
	Number of observations	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000										
		R. H.		R. H.		R. H.		R. H.		R. H.		R. H.		R. H.		R. H.		R. H.										
		q	Mean Dep.	q	Mean Dep.	q	Mean Dep.	q	Mean Dep.	q	Mean Dep.	q	Mean Dep.	q	Mean Dep.	q	Mean Dep.	q	Mean Dep.									
Barksdale Field, La.	30	13.2	89	+3	10.6	58	-6	9.7	60	-6	8.4	58	-8	7.6	59	-5	6.9	59	-1	5.7	56	+1	4.1	55	+1	2.9	47	0
Billings, Mont.	20	5.7	55	-1							5.8	48	-1	5.0	49	+1	4.4	50	+1	3.7	51	+1	2.3	50	-3	1.4	43	-6
Boston, Mass.	28	8.2	85		7.2	66		6.7	68		5.6	62		4.8	55		3.6	44		3.2	42		2.3	38		1.2	29	
Cheyenne, Wyo.	30	6.5	66	0							6.9	59		6.2	49	-1	6.2	49	-1	5.2	48	0	3.8	53	+3	2.8	64	+11
Chicago, Ill.	30	7.7	76	-5	7.5	63	-4	6.6	64	+2	5.6	63	+5	4.4	52	0	3.7	47	-3	3.0	44	-3	2.4	48	-1	2.1	56	+9
Coco Solo, Canal Zone.	27	18.3	95		16.3	85		14.5	84		12.6	81		11.2	80		9.5	77		8.2	74		6.8	82		4.9	79	
El Paso, Tex.	30	10.6	63	-2							9.6	51	-5	8.7	52	-5	7.9	58	-5	7.2	61	-1	5.3	67	+4	3.7	64	+8
Fargo, N. Dak.	29	6.7	78	-1	7.0	68	+1	6.4	62	-1	5.6	59	+2	5.0	57	+3	4.4	57	+5	3.7	57	+5	2.7	58	+6	1.8	55	+7
Kelly Field, Tex.	30	12.5	74	-15	12.5	67	-15	10.4	60	-14	9.0	59	-11	8.0	61	-7	6.8	59	-4	5.6	55	-3	4.4	59	+8	3.3	61	+11
Lakehurst, N. J.	26	8.6	93	+2	7.1	63	-5	6.0	60	-6	5.6	60	-2	4.4	49	-7	3.6	48	-5	2.9	43	-5	1.7	37	-3			
Maxwell Field, Ala.	27	12.6	83	-6	11.0	70	+2	9.2	64	-2	7.9	59	-5	6.6	54	-2	5.6	54	+2	4.8	50	+2	3.3	43	-3	2.0	35	-5
Mitchel Field, N. Y.	24	8.9	90	-1	8.3	76	-1	7.8	76	+2	6.9	72	+3	5.4	58	-5	4.5	53	-5	3.9	51	-3	2.6	46	-2			
Nashville, Tenn.	29	10.2	84	-2	10.0	70	+2	9.2	69	+1	8.0	67	-1	6.3	56	-5	5.2	51	-5	4.4	48	-4	2.9	42	-4	1.8	36	-3
Norfolk, Va.	24	11.3	84	+4	9.7	71	+1	8.1	69	+2	6.8	61	-2	5.4	52	-7	4.4	45	-9	3.6	40	-9	2.7	38	-7	1.7	33	-9
Oakland, Calif.	30	8.7	85		9.0	70		6.9	44		5.1	35		4.0	30		3.2	28		2.9	27		2.0	27		1.4	28	
Oklahoma City, Okla.	30	11.0	77	-3	10.7	68	-5	9.5	54	-8	8.6	54	-6	7.6	54	-4	6.9	56	0	6.1	59	+4	4.2	57	+5	2.9	55	+6
Omaha, Nebr.	29	8.6	73	-9	8.6	64	-7	7.7	56	0	6.8	54	-2	5.9	51	+1	5.0	49	0	4.2	49	+1	3.3	53	+6	2.2	49	+6
Pearl Harbor, Hawaii.	30	14.2	84	+4	12.9	75	-2	12.1	81	+1	10.3	77	+1	8.4	71	+1	6.2	53	0	4.7	42	0	3.3	24	-7	1.3	19	-2
Pensacola, Fla.	28	14.2	93	+7	12.8	75	-3	11.1	72	-3	9.3	67	-3	8.1	67	0	6.7	60	-2	5.4	52	-5	3.6	44	-8	2.5	39	-9
St. Thomas, Virgin Islands.	30	19.2	75		18.9	91		15.6	86		12.7	78		10.8	72		8.9	66		7.2	60		4.5	48		3.0	39	
Salt Lake City, Utah.	30	6.3	53								7.2	44		5.9	38		5.0	38		4.5	41		3.6	48		2.9	67	
San Diego, Calif.	29	11.4	85	+6	10.8	76	-3	8.8	48	-6	7.1	38	-4	6.0	35	+2	5.4	36	+5	5.0	39	+9	3.7	41	+11	2.5	39	+14
Sault Ste. Marie, Mich.	30	7.3	87		6.6	72		5.8	69		5.2	68		4.4	64		3.8	61		3.4	61		2.3	56		1.4	47	
Scott Field, Ill.	27	8.1	82	-5	7.7	59	-2	7.4	60	+1	6.2	56	-1	5.0	49	-4	4.3	46	-6	3.7	44	-4	2.8	44	-2	2.1	49	+5
Seattle, Wash.	11	9.2	73		8.7	74		8.0	66		6.9	56		5.7	50		4.6	44		3.7	41		2.3	34		1.4	34	
Selfridge Field, Mich.	30	7.8	83	-3	6.8	64	-5	6.0	64	0	5.3	64	+2	4.6	61	+3	3.8	57	+4	3.2	52	+2	2.1	46	+1	1.4	43	+2
Spokane, Wash.	29	6.8	78	+7				6.3	53	+2	5.3	50	+2	4.7	51	+1	4.2	54	0	3.5	53	0	2.1	47	-1	1.4	48	+2
Washington, D. C.	29	9.5	84	+5	8.5	70	+4	7.3	66	+4	6.4	63	+2	5.4	58	-2	4.7	53	0	4.0	51	+1	3.0	47	+1	2.1	44	+7
Wright Field, Ohio.	29	7.9	89	-1	8.0	67	-3	7.2	63	-1	6.4	62	-2	5.0	54	-4	4.7	57	+3	4.2	57	+5	2.8	48	+1	2.0	45	+2

TABLE 3.—Mean free-air barometric pressures (*P*), in mb, and equivalent potential temperatures (*θ*), in °A, obtained by airplanes during September 1937

Stations	Altitude (meters) m. s. l.																							
	Surface			500		1,000		1,500		2,000		2,500		3,000		4,000		5,000						
	Number of observations	P	θ.	P	θ.	P	θ.	P	θ.	P	θ.	P	θ.	P	θ.	P	θ.	P	θ.					
Barksdale Field, La.	30	1,010	329	959	330	905	330	854	329	805	329	758	329	714	328	632	329	558	330					
Billings, Mont.	20	894	312					851	318	802	318	754	318	710	318	626	316	551	317					
Boston, Mass.	28	1,018	307	960	311	905	312	852	313	802	314	764	315	710	317	626	320	554	321					
Cheyenne, Wyo.	30	815	320					803	326	755	329	712	328	630	327	556	325							
Chicago, Ill.	30	996	309	959	314	905	313	853	313	803	313	754	314	710	314	626	317	552	321					
Coco Solo, Canal Zone.	27	1,009	348	955	347	902	345	850	342	802	341	756	338	712	337	630	338	558	337					
El Paso, Tex.	30	883	335					852	337	804	337	758	337	714	335	632	333	559	332					
Fargo, N. Dak.	29	983	304	957	310	902	313	849	314	799	315	752	316	707	316	623	318	549	319					
Kelly Field, Tex.	30	994	331	961	335	907	333	855	332	807	330	760	329	716	328	633	329	560	330					
Lakehurst, N. J.	26	1,013	309	958	312	903	312	850	314	801	314	753	314	708	314	624	315							
Maxwell Field, Ala.	27	1,011	328	960	328	906	326	854	326	805	325	758	324	713	325	634	325	560	327					
Mitchel Field, N. Y.	24	1,015	310	960	314	904	316	851	317	802	318	764	317	710	319	628	319							
Nashville, Tenn.	29	996	318	960	324	905	325	853	324	804	323	757	323	712	323	630	324	556	324					
Norfolk, Va.	24	1,017	322	960	322	906	319	854	319	804	319	757	320	713	320	630	322	556	325					
Oakland, Calif.	30	1,014	310	957	319	903	322	851	320	802	320	755	319	712	320	629	321	556	323					
Oklahoma City, Okla.	30	971	326	959	328	905	330	854	331	805	330	759	331	714	330	632	328	558	328					
Omaha, Nebr.	29	982	315	959	319	904	322	853	322	804	322	756	322	712	322	629	323	555	324					
Pearl Harbor, Hawaii.	30	1,015	334	960	336	906	335	855	333	806	330	759	328	716	327	635	326	562	328					
Pensacola, Fla.	28	1,016	332	960	335	906	333	855	331	806	329	759	328	715	328	633	328	559	329					
St. Thomas, Virgin Islands.	30	1,014	356	959	356	906	349	854	343	806	341	759	338	716	336	634	333	561	335					
Salt Lake City, Utah.	30	872	318					851	328	802	328	755	327	712	327	629	327	558	328					
San Diego, Calif.	29	1,012	323	956	326	903	330	852	330	804	330	757	330	713	330	632	330	559	330					
Sault Ste. Marie, Mich.	30	990	305	958	307	902	308	849	309	799	310	750	311	706	313	622	314	547	316					
Scott Field, Ill.	27	1,003	309	961	316	906	318	854	318	804	318	757	319	712	319	630	322	555	324					
Seattle, Wash.	11	1,018	315	960	317	904	320	852	322	803	322	756	322	712	321	630	321	556	321					
Selfridge Field, Mich.	30	996	308	959	310	904	310	851	311	801	311	753	312	708	314	624	315	549	318					
Spokane, Wash.	29	946	308			902	315	850	315	801	315	753	316	708	315	624	315	549	315					
Washington, D. C.	29	1,019	314	962	316	907	316	854	317	804	318	757	319	712	320	629	322	555	325					
Wright Field, Ohio.	29	989	308	960	315	905	317	852	317	803	316	755	318	711	320	627	320	553	323					

TABLE 4.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during September 1937

[Wind from N=360°, E=90°, etc.]

Altitude (m) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (309 m)		Billings, Mont. (1,088 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (153 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (283 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (410 m)		Nashville, Tenn. (194 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface.....	356	1.8	53	1.1	317	1.7	316	1.3	273	2.5	220	0.8	45	0.6	288	0.9	215	0.5	30	0.8	76	2.1	262	0.3	100	0.3
500.....	97	3.7	97	3.7	316	4.7	316	4.7	231	3.6	153	0.6	292	1.6	219	1.0	163	3.4	97	4.2	266	0.8	153	2.5	153	2.5
1,000.....	104	3.8	104	3.8	307	5.3	307	5.3	255	3.8	267	2.1	282	2.9	269	4.0	150	3.4	102	3.3	282	1.3	187	12.3	187	12.3
1,500.....	111	1.9	41	0.2	301	5.2	267	4.2	279	3.1	292	4.1	263	5.7	123	2.2	101	2.8	70	0.6	257	1.8	257	1.8	257	1.8
2,000.....	152	1.8	294	0.3	273	1.4	296	6.3	271	3.5	285	4.8	286	3.4	292	5.9	294	7.2	74	2.0	102	0.8	133	1.2	273	2.4
2,500.....	225	12.2	199	0.2	269	4.0	295	6.0	265	4.5	298	5.2	294	4.9	292	7.4	290	7.6	49	12.6	240	0.4	199	3.2	272	2.3
3,000.....	253	2.6	267	0.6	277	5.5	293	6.9	275	5.5	298	7.4	301	4.5	289	7.4	292	8.8	38	3.1	288	1.7	189	3.6	273	2.8
4,000.....	275	2.8	280	2.1	267	5.5	267	5.5	267	7.0	267	7.0	267	7.0	290	8.6	290	8.6	320	0.7	214	5.2	300	4.8	300	4.8
5,000.....	257	2.5	257	2.5	269	7.1	269	7.1	285	7.2	285	7.2	285	7.2	291	6.9	291	6.9	227	4.6	199	6.0	199	6.0	199	6.0

Altitude (m) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Harbor, Hawaii ¹ (68 m)		Pensacola, Fla. ¹ (24 m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,294 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washing- ton, D. C. (10 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface.....	346	1.1	257	0.4	146	1.7	150	1.4	28	2.3	22	3.6	117	0.5	159	4.0	342	1.1	46	0.5	141	0.7	120	1.5	316	1.1
500.....	323	3.3	257	1.6	166	3.9	180	4.5	70	5.5	54	3.2	176	2.9	344	2.4	247	1.5	89	0.5	89	0.5	313	2.5	313	2.5
1,000.....	320	2.9	312	1.1	211	7.0	222	6.4	78	6.6	335	1.5	224	2.1	161	5.4	341	1.4	273	4.7	155	0.4	191	0.9	302	3.1
1,500.....	299	4.5	167	0.4	236	5.4	252	6.4	83	5.5	356	1.3	289	2.5	29	0.7	281	6.4	81	0.2	251	1.0	296	3.8	296	3.8
2,000.....	286	5.5	187	0.7	252	4.1	274	5.4	87	4.6	351	2.9	305	3.6	180	5.4	142	2.5	283	7.9	330	1.6	247	1.8	300	3.8
2,500.....	305	7.1	192	2.2	262	3.9	289	5.1	87	4.5	343	3.0	301	4.0	193	4.4	146	4.3	291	8.9	303	2.0	251	2.9	290	3.8
3,000.....	292	8.0	196	2.0	283	3.5	301	6.3	78	4.1	336	3.2	304	4.1	217	4.0	159	4.8	291	8.9	303	2.0	251	2.9	290	3.8
4,000.....	301	7.9	76	0.2	324	1.2	302	8.4	83	4.1	272	2.1	299	7.1	252	4.4	173	5.2	291	8.9	303	2.0	251	2.9	290	3.8
5,000.....	283	9.9	283	9.9	283	9.9	283	9.9	283	9.9	283	9.9	283	9.9	283	9.9	283	9.9	283	9.9	283	9.9	283	9.9	283	9.9

¹ Navy stations.

TABLE 5.—Maximum free air wind velocities meters per second, for different sections of the United States based on pilot balloon observations during September 1937

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum ve- locity	Direction	Altitude (m) M. S. L.	Date	Station	Maximum ve- locity	Direction	Altitude (m) M. S. L.	Date	Station	Maximum ve- locity	Direction	Altitude (m) M. S. L.	Date	Station
Northeast ¹	37.0	NW	1,720	20	Newark	31.8	W	4,860	14	Albany	40.8	WNW	7,720	7	Cleveland.
East-Central ²	27.8	WSW	570	18	Cincinnati	25.6	WSW	4,240	18	Washington	43.2	SSW	11,160	28	Greensboro.
Southeast ³	22.8	ENE	670	29	Tampa	18.0	WSW	4,120	26	Spartanburg	33.2	SW	9,840	28	Charleston.
North-Central ⁴	31.2	W	2,270	18	Detroit	32.2	NNW	4,970	19	Detroit	34.8	NW	7,670	5	Sault Ste.
Central ⁵	32.7	SSW	1,480	23	Omaha	35.0	WNW	4,150	16	Omaha	42.0	W	10,840	6	Marie.
South-Central ⁶	26.2	NNW	2,500	16	Memphis	26.4	NNW	2,510	16	Memphis	36.2	W	9,350	11	Memphis.
Northwest ⁷	20.6	SW	2,500	30	Medford	36.2	SW	3,200	30	Medford	47.0	NE	9,290	1	Portland.
West-Central ⁸	28.0	WSW	2,500	22	Winnemucca	32.4	WSW	3,760	22	Winnemucca	50.0	WSW	11,560	7	Rock Springs.
Southwest ⁹	20.7	SW	1,370	19	Las Vegas	33.1	SSW	3,360	20	Las Vegas	32.6	W	8,780	24	Winslow.

¹ Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.² Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee and North Carolina.³ South Carolina, Georgia, Florida, and Alabama.⁴ Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.⁵ Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.⁶ Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.⁷ Montana, Idaho, Washington, and Oregon.⁸ Wyoming, Colorado, Utah, northern Nevada, and northern California.⁹ Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.